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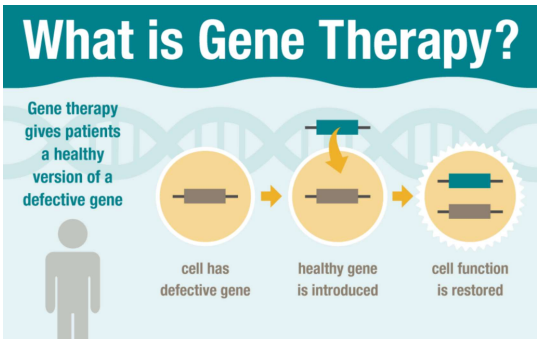
Gene Therapy at St. Jude

Gene therapy treats genetic diseases by giving patients a healthy version of a defective gene. St. Jude is developing innovative gene therapy approaches for patients with blood diseases, immune disorders and other conditions.

Potential for a Cure



A baby is born with a defective gene, leading to a life-threatening disease. Standard therapies are limited; the child is faced with battling a chronic condition for life.

But perhaps there is an alternative – one that may lead to a permanent cure.

Gene therapy is designed to restore the function of a patient's defective gene by introducing a healthy copy, with the potential to permanently correct a genetic disease. This compelling concept has intrigued the medical community for more than 20 years. While still primarily performed as part of research studies, gene therapy is becoming more widely adopted for clinical treatment of some conditions.

GENE THERAPY FOR SCID:

Bubble Boy Disease

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X-linked SCID, the most common form of SCID, is caused by defects in a gene encoding a critical protein called the common gamma chain. Without it, immune system cells called T cells, B cells and natural killer cells do not develop normally.

With the aim of pioneering a safe, effective gene therapy approach, St. Jude scientists have spent years developing an innovative vector for X-linked SCID. The vector is manufactured in the on-site Good Manufacturing Practice (GMP) facility using a process developed at St. Jude. The process, which uses stable cultured cell lines to produce the vector, addresses the challenge of manufacturing large quantities of clinical-grade vector in a reproducible manner.

The vector has been designed with features to reduce the risk of activating cancer-causing genes. It has also been subjected to extensive laboratory testing to ensure it does not readily insert into chromosomes near such genes.

Clinical trials led by St. Jude and the National Institute of Allergy and Infectious Diseases (NIAID) have recently confirmed that this vector can safely provide long-lasting health benefits to patients with X-linked SCID.

Read about the St. Jude trial: LVXSCID-ND: Gene Transfer for X-Linked Severe Combined Immunodeficiency in Newly Diagnosed Infants

Featured Research: Gene Therapy Provides Cure for SCID

St. Jude researchers have cured X-linked SCID in eight infants treated at St. Jude and UCSF Benioff Children's Hospital San Francisco. As of early 2019, eight infants have received the novel combination therapy and have not shown any immediate side effects. The patients have begun developing healthy immune systems and have started responding to vaccinations. This study also demonstrated that the gene-corrected cells could be produced reliably and in significant quantities to treat a large number of patients.

Read full results published in the *New England Journal of Medicine*.

Learn more about the study.

For updates on COVID-19, please read.

Gene therapy offers hope of a cure

Scientists at St. Jude developed a novel gene therapy for children born with a rare immune disease

Gene Therapy for Hemophilia and Other Blood Disorders

In 2014, St. Jude investigators and colleagues published historic results from a gene therapy trial for hemophilia B. A vector developed and manufactured at St. Jude had transformed the lives of young men with this inherited bleeding disorder.

Andrew M. Davidoff, MD, St. Jude Children's Research Hospital

Hemophilia B is caused by defects in the gene for factor IX, a blood clotting protein. Hemophilia B can be managed with lifelong regular injections of factor IX protein, which can cost $250,000 per year.

Years after receiving a single dose of gene therapy, patients on the hemophilia B trial continued to produce their own clotting factor from the normal transferred gene with minimal side effects. The treatment dramatically decreased their need for protein replacement injections, and some were able to participate in sports without worrying about bleeding.

The trial stemmed from a decade-long collaboration between St. Jude and University College London to discover effective gene therapies for this blood disorder. The St. Jude team was led by Andrew Davidoff, MD, chair of St. Jude Surgery and Arthur Nienhuis, MD, of St. Jude Hematology. Vector development was a critical aspect of the project, with years of careful improvements required to produce sufficient levels of factor IX to relieve symptoms.

Read about the hemophilia B study.

St. Jude and University College London are currently collaborating on another Phase I/II gene therapy clinical trial for adult men with hemophilia B, scheduled to launch in the U.S. in early 2019.

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clinical trials. In gene therapy, new genetic material (DNA or RNA) is introduced into a patient's cells, most often via a disabled virus called a vector. The new genetic material either floats free in the cells or is inserted into the patient's chromosomes, depending on the type of vector.

St. Jude has played a key role in vector development, pioneering innovative vector designs for patients with hemophilia and the devastating immune disorder X-linked severe combined immunodeficiency (SCID). Other vectors are in development. St. Jude has also developed exclusive manufacturing processes to produce large amounts of clinical-grade genetic material for clinical trials.

Vectors designed and manufactured at St. Jude have already helped transform the lives of patients participating in gene therapy clinical trials for immune and blood disorders.

THE FUTURE OF GENE THERAPY:

Challenges and Opportunities

To date, results from clinical studies of gene therapies pioneered at St. Jude have been promising. It will be important to follow patients for many years to confirm the therapy's long-lasting safety and health benefits.

St. Jude researchers are now focused on applying investigational gene therapy approaches to treat X-linked SCID, hemophilia B and a related disorder, hemophilia A. The long-term vision is to apply these technologies to other genetic diseases, such as sickle cell disease, and to explore applications in developing effective immune therapies for cancer.

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